

**What is claimed is:**

1 1. A process for producing a microstructured tool insert for injection molding a  
 2 part which is produced from a synthetic material, a metal or from a ceramic material  
 3 and which comprises an arrangement of microstructures which are formed on an  
 4 outer surface of the synthetic material part and have two different predetermined  
 5 depths, said process comprising:

6 (a) photo-lithographically masking the front side of a first wafer with a  
 7 first etching mask which corresponds to an arrangement of microstructures,

8 (b) micro-structuring the front side of the first wafer by means of  
 9 plasma etching to form an arrangement of first microstructures which are formed on  
 10 the front side of the wafer and have a first predetermined depth,

11 (c) removing the first etching mask from the front side of the first wafer,

12 (d) photo-lithographically masking the rear side of the first wafer with a  
 13 second etching mask which corresponds to an arrangement of second  
 14 microstructures, which are to be in fluid connection with the first microstructures on  
 15 the front side of the first wafer,

16 (e) microstructuring the rear side of the first wafer by means of plasma  
 17 etching to form an arrangement of second microstructures which form cavities which  
 18 have a first orifice on the rear side of the first wafer and issue into the first  
 19 microstructures on the front side of the first wafers or have a second orifice on the  
 20 front side of the first wafer, said cavities having inclined side walls and a tapered  
 21 cross section the width of which increases with the distance with respect to the rear  
 22 side of the first wafer,

23 (f) removing the second etching mask from the rear side of the first  
 24 wafer,

25 (g) attaching the rear side of the first wafer to a carrier substrate to form  
 26 a master,

27 (h) applying an electrically conductive thin layer to the microstructured  
 28 front side of the first wafer and to the carrier substrate surfaces which are accessible  
 29 through the mentioned cavities,

30 (i) electrochemically depositing a metal layer on the front side of the  
 31 first wafer and in the cavities which are present therein and are formed by the  
 32 second microstructures,

33 (j) making planar the outer surface of the deposited metal layer, and

34 (k) separating the metal layer from the master, wherein the separated  
35 metal layer can be used as a tool insert for injection molding a part.

1 2. The process of Claim 1 wherein the first wafer is a silicon wafer.

1 3. The process of Claim 1 wherein the carrier substrate is a glass wafer.

1 4. The process of Claim 1 wherein the carrier substrate is a silicon wafer.

1 5. The process of Claim 1, wherein the deposited metal layer is a nickel layer.

1 6. The process of claim 1 wherein the microstructuring of the rear side of the  
2 first wafer is performed by means of through-etching the first wafer with an  
3 undercut, so that the microstructures formed have said cross-section the width of  
4 which increases with the distance with respect to the rear side of the first wafer.

1 7. A process for injection molding a part which is produced from a synthetic  
2 material, a metal or from a ceramic material and which comprises an arrangement of  
3 microstructures which are formed on an outer surface of the synthetic material part  
4 and have two different predetermined depths, wherein a tool for injection molding is  
5 used which is formed from a first and a second tool half, said process comprising:

6 (a) installing a first tool insert as a first tool half which serves to shape  
7 the arrangement of microstructures, wherein the first tool insert is produced  
8 according to a process comprising the steps of photo-lithographically masking the  
9 front side of a first wafer with a first etching mask which corresponds to the  
10 arrangement of microstructures, micro-structuring the front side of the first wafer by  
11 means of plasma etching to form an arrangement of first microstructures which are  
12 formed on the front side of the wafer and have a first predetermined depth,  
13 removing the first etching mask from the front side of the first wafer, photo-  
14 lithographically masking the rear side of the first wafer with a second etching mask  
15 which corresponds to an arrangement of second microstructures, which are to be in  
16 fluid connection with the first microstructures on the front side of the first wafer,  
17 microstructuring the rear side of the first wafer by means of plasma etching to form  
18 an arrangement of second microstructures which form cavities which have a first  
19 orifice on the rear side of the first wafer and issue into the first microstructures on  
20 the front side of the first wafers or have a second orifice on the front side of the first  
21 wafer, removing the second etching mask from the rear side of the first wafer,

22 bonding the rear side of the first wafer to a carrier substrate to form a master,  
23 applying an electrically conductive thin layer to the microstructured front side of the  
24 first wafer and to the carrier substrate surfaces which are accessible through the  
25 mentioned cavities, electrochemically depositing a metal layer on the front side of  
26 the first wafer and in the cavities which are present therein and are formed by the  
27 second microstructures, making planar the outer surface of the deposited metal  
28 layer, and separating the metal layer from the master,

29 (b) installing a second tool insert as a second tool half which is arranged  
30 opposite the first tool half,

31 (c) closing the tool for injection molding formed from the first and  
32 second tool insert,

33 (d) injecting a material melt into the cavity between the first and the  
34 second tool insert,

35 (e) cooling the injected material melt and

36 (f) ejecting from the molding tool for injection molding a part which is  
37 formed by the setting of the injected material melt and which comprises  
38 microstructures with inclined surfaces which enable the part to be removed from the  
39 molding tool.

1 8. A process for producing a predetermined portion of a mold, said mold being  
2 used for molding a part having microstructures, said process comprising:

3 (a) forming at least one first microstructure on a front side of a wafer,  
4 said first microstructures having a first predetermined depth,

5 (b) forming at least one second microstructure on a rear side of the  
6 wafer, said second microstructures having a second predetermined depth and  
7 inclined walls,

8 (c) bonding the rear side of the wafer to a carrier substrate to form a  
9 master,

10 (d) depositing metal on the wafer that fills the first and the second  
11 microstructures, and

12 (e) separating the metal layer from the master.

1 9. The process of claim 8 wherein forming said first microstructure includes  
2 masking the front side of the wafer with a first etching mask which corresponds to  
3 the first microstructure.

1 10. The process of claim 8 wherein forming the first microstructure includes  
2 etching the front side of the wafer after masking this side with the first etching mask.

1 11. The process of claim 10 wherein the etching is plasma etching.

1 12. The process of claim 8 wherein forming the second microstructure includes  
2 masking the rear side of the wafer with a second etching mask which corresponds to  
3 the second microstructure.

1 13. The process of claim 12 wherein forming the second microstructure includes  
2 etching the rear side of the wafer after masking of this side with the second etching  
3 mask.

1 14. The process of claim 13 wherein the etching is plasma etching.

1 15. The process of claim 8 wherein depositing of the metal layer includes applying  
2 an electrically conductive thin layer to the front side of the wafer and to the carrier  
3 substrate surfaces followed by electrochemically depositing a metal layer on the front  
4 side of the first wafer and in the first microstructure and the second microstructure.

1 16. A process for molding a part which includes microstructures using a mold  
2 having first and second mold portions, said process comprising:

3 (a) installing a first tool insert into a predetermined portion of the first  
4 mold portion, said first tool insert serving to shape the arrangement of  
5 microstructures, wherein the first tool insert is produced according to a process  
6 comprising the steps of forming at least one first microstructure on a front side of a  
7 wafer, said first microstructures having a first predetermined depth, forming at least  
8 one second microstructure on a rear side of the wafer, said second microstructures  
9 having a second predetermined depth and inclined walls, bonding the rear side of  
10 the wafer to a carrier substrate to form a master, depositing metal on the wafer that  
11 fills the first and the second microstructures, and separating the metal layer from the  
12 master,

- 13           (b)     providing a second mold portion,
- 14           (c)     forming the mold by bringing the first and second mold portions
- 15 into contact with one another, said first tool insert extending into a cavity formed
- 16 upon contact of said first and second mold portions,
- 17           (d)     introducing a material melt into the mold formed by the first and
- 18 second mold portions,
- 19           (e)     cooling the material melt and
- 20           (f)     removing the cooled material melt from the mold.